ANCIENT HISTORY OF GLASS

VOLUME 1

BY

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CONTENTS

ILLUSTRATIONS

1.	Core Formed Vessels	"Phaidon Guide to Glass" p 33 Felice Mehlman c 1982 Phaidon Press Ltd
2.	Portland Vase	"5000 Years of Glass-Making The History of Glass" p 24 ill J.R.Vaura Arta-Prague
3.	Two Handled Jug	"The Encyclopedia of Glass" p 22 edited by Phoebe Phillips Crescent Books New York c 1981
4.	Mosaic Bowl	"The Encyclopedia of Glass" p 31 edited by Phoebe Phillips Crescent Books New York c 1981
5.	Venetian Goblets	"5000 Years of Glass- Making The History of Glass" p 101 J.R. Vavra Art-Prague

When you have prepared the foundations of the Glass Furnace you must take care to choose the right month. If the workmen begin the construction of the furnace in the right month, you must supervise them and lend a hand at the work. Make sure you find a still-born child, carry it into the workshop, taking precautions, lest a foreigner or an unclean person cross the threshold. On the day of lighting the furnace and the first charge offer the Gods a sacrifice close to the body of the child. You yourself must light the fire and place the "batch" into the hearth. Let the stokers wash themselves clean before approaching the furnace and hearth. Use styrax wood for fuel. The logs must be sufficiently thick and without bark. They must never be left lying around in piles or bundles, must be cut in the month of August and stored under a roof of lamb skins.

a tablet from 7th Century in
the reign of
Assurbannipal Babylon

CONCEPTION

Glass. A medium so familiar and widely used the the 20th century that it is amazing to know that this versatile medium is over four thousand years old.

As the opening extract reveals, glass and its manufacture has always been a subject fraught with superstition and clouded with mystery.

I have based this thesis on a fragment of the history of glass. My motive, a desire to discover for myself the secrecy that surrounds it -what it is, how it began, who discovered it (who took the credit) and how glass developed from a tiny precious medium to one of the most indispensable materials in the world utilized in all aspects of life.

I will discuss the development of handmade glass, from its origins to a peak of skill and mastery achieved with Venetian glass in the First Century.

Initially I will explain what glass actually is to give the reader an insight into the material and subject concerned. We will then explore its natural evolution, its man-induced evolution and its subsequent four thousand year progression to the rule of the Roman empire.

Although only a short chapter in the history of glass, I feel it serves an introduction from which we can then discover its continuing and diverse history with a basic knowledge of how glass began.

THE WORLD BEGAN

Glass is a generic term for what is commonly a man-made vitreous substance. It is composed of two main ingredients, a silica body (sand, quartz or flint) and an alkaline body (soda or potash) which is mixed with other additions and melted at a high temperature until an amorphous and homogeneous mass is obtained. This molten mixture is glass and in its viscous state (which is only when it is hot) it can be manipulated, molded, poured, blown, cut and shaped until it has obtained the desired form.

All objects which involve the use of molten glass must be cooled gradually from its molten state to room temperature to insure uniform contraction throughout the body of the glass. This gradual cooling process known as "annealing" minimizes porisity and imparts strength and durability to the glass.

Since glass cools to quickly for its molecules to arrange themselves as they would in a solid substance, glass is generally regarded as a super-cooled liquid. The random arrangement of the molecules contributes to the fragility of glass as it does not have the molecular bondage to give it tensile strength.

The composition of glass can be varied via the changing of materials in a glass melt or the varying of the proportion of these materials in order to produce a glass with specific qualities. For example, a glass with a high lead content will have a brilliant finish and a heaviness, whilst still being extremely elastic in its molten state to enable it to be blown into delicate forms. Lead glass is generally regarded as most suitable for cut glassware as the lead makes the glass softer and thus facilitates cutting and engraving.

Soda-lime glass (name derived from its high lime content - not colour) is lightweight and does not have such a brilliant lustre. It is the ideal base for most commercial pressed glass due to its ductile and lower cost of manufacture. The recipe of a glass can generally be altered to suit the function and its suitability to the finished piece.

Glass can be coloured by the addition of metallic oxides or decolourized by agents such as maganese and arsenic which neutralize the impurities found in sand which would otherwise tint the glass an unfavourable colour.

Whilst most qualities of glass can be manipulated to obtain specific properties care must always be taken to

ensure that the recipe is a stable one as a lack of, or overabundance of, any one ingredient could result in a glass with low durability or poor tensile strength.

ON THE FIRST DAY

The very first glass to be made was by:

a. Adam and Eve

b. Jeannie Little

c. Harvy Littleton

d. Someone Small

Answer? Natural forces actually! (The above was a trick question!) Long before Adam and Eve and Harvy Littleton, glass was being created by elements of nature.

Lightening had the force and generated heat to be able to fuse large quantities of quartz sand together when it struck on a beach or desert to create irregular glass tubes known as fulgurites. Likewise, the intense heat produced by a volcanic eruption has the ability to melt highly siliceous substances to produce a black glass commonly known as obsidian. Obsidian was popularly used by primitive man in much the same way as flint to produce tools and weapons.

Objects known as tektites (or thunder eggs) are also a crude composition of glass created by nature. Thought to be of meteoric origin scientists believe that they are the product of particles that have binded in the intense heat of the solar system as they fell to earth. They resemble tiny glass meteorites and are found in every country except South America and Antarctica.

Finally, glass also makes up the skeleton of a single-celled organism known as a radiolaria. This microscopic sea-creature builds its skeleton out of silica to create a delicate and very intricate webbing of glass as its support.

Thus, although glass in a somewhat different form has been present from the beginning of time in a natural state it was not until many years later that glass as an independent substance, recognized for its own properties was finally invented. This discovery was to herald the beginning of glass as we know it in todays world.

Who, when he first saw the sand and ashes by casual intenseness of heat melted into a metal line, form, rugged with excrescence and clouded with impurities would have imagined that in this shapeless mass lay concealed so many conveniences of life as would in time constitute a great part of the happiness of the world?

Dr Samuel Johnson
(great English lexicographer
and
critic)

GLASS IS BORN

It was in a roundabout way that the Egyptians managed to transform the shapeless mass into glass. Although they cannot be credited to initially recognizing and using glass as an independent substance, they did ultimately rule the country that did, thus making its discovery their own.

Archaeological finds suggest that it was actually the Mesopotamians who invented glass - their discovery quickly lost to the Egyptians who invaded and conquered Mesopotamia in the eighteenth dynasty. Pharoh Thutmose, ruler of that time, carried the invention of glass back to his homeland and developed the medium from historical obscurity into a prosperous industry. Until this time, the Egyptians had developed two major decorative mediums which can be directly associated with the invention of glass, glazes and faience, thus making their appropriation not entirely misplaced.

A popular and probable theory is that glass evolved out of ceramic materials and is actually a by-product of glaze. This theory arises from the fact that glaze is a composition of an alkali and alkaline body, the two major components of glass. The ingredients of a glaze are in the incorrect proportions and underfired to convert the components into glass, but had these two factors been altered it is possible that glass would result.

The second theory is that glass was developed out of a medium that the Egyptians had invented and had been using for the previous one thousand years -faience. Faience is made from powdered quartz or quartz sand, clay and perhaps some limestone to make the mixture cohere when heated. This would form a white body which after being heated till it bonded would be painted lightly with a solution of glaze and reheated to result in a bead with a beautifully coloured, shiny surface. Faience was used intensively for the manufacture of beads, plaques and seals. Glass is made from the same constituents of faience with the addition of a much larger amount of alkali and soda, heated to a higher temperature to result in glass.

It is suspected that at some period during the one thousand years of faience making the correct formula and conditions to make glass must have been accidentally discovered and that from simple observation of this, the fabrication of real glass must have sprung.

Glass could also be a by-product of bronze-smelting since there are close technical ties between the melting process of these two materials. The slag produced from smelting was often of a glassy state. This similarity may have been developed using the knowledge of bronze smelting to apply to glass.

Pliny, an historian of antiquity, cast the origins of glassmaking to the Phoenicans, well renowned merchants and traders of the sea. In his writings Pliny records that during one of the many voyages of the Phoenicans they cast ashore one day to cook a meal. Finding no rock on the beach on which to set their cauldrons, they took ashore some blocks of natron from their cargo to use as supports.

Since natron is a form of soda and it was placed on the sand, a silica, when the fire was lit it generated so much heat that "a molten liquid ran forth in streams". Yes, streams! A drop or two sure, but a stream! Pliny's exaggeration is enough to make this story far-fetched, however other factors also indicate that this tale is more one of fanciful wishing. Although the Phoenican merchants and sailors were the chief distributors of glass goods, it is extremely doubtful that they were the discoverers of glass.

The art of glassmaking began in Egypt four thousand years before the birth of Christ.

The Egyptians used tiny coloured opaque and faintly translucent pieces of glass as an inlay on the gold surface on the sarcophagi (stone coffin in a tomb).

In 3,400 B.C. pale green glass beads were being placed in graves as an object of value for the "next life". Mistaken on their discovery as quartz, it was not until the nineteenth century that Egyptologist, Sir W.M. Flinders-Petrie conducted chemical research on the beads and discovered that they were glass. It is impossible to ascertain whether the production of the beads was intentional or accidental as a result of glazing of bricks and ceramics.

The oldest piece of glass known to be made intentionally was also discovered by Sir W.M. Flinders-Petrie in Egypt.

It is an artificial eye which bears the name of Pharoh Amenhotep I who reigned in the middle of the sixteenth century B.C.

Glass manufacture developed rapidly in Egypt under the rule of Thothmes III. Egypt had widened its boundaries

and was enjoying a richness in land and agriculture. Cultural activities reached their peak and just a century after the discovery of glass the first glass vessels were produced. In Egypt and Mesopotamia these vessels were manufactured exclusively from techniques particular to that age, known as core-forming, pad glass and, tube-blown glass.

Core-forming was the most popular and developed technique of making vessels. It involved making a core (or mould) out of organic materials on which the glass could then be fashioned.

In 1967 scientists Bimson and Werner carried out tests on original core material derived from two core-formed vessels in an effort to determine what the core was made of. It was discovered that the core was two layers of a friable porous mass. The inside layer and thus the bulk of the material consisted of fragments of plants (probably as dung) and a highly ferruginous clay mixed with ground limestone. The outer layer was nearly all ground limestone.

Their subsequent examination of a further sixty-two samples of core material showed that the above mixture had been used successively until 750 B.C. when the ingredients changed to consist of sand grains cemented together with iron oxide.

This core was attached to the end of a wooden or copper pipe. When the ingredients had binded together the core was repeatedly dipped into a pot of molten glass or glass trails were wrapped around it. The core and its mass of glass was then smoothed against a firm surface so that a thick layer of glass adhered to the core. A decorative pattern was given to the glass by dragging a pointed utensil along the surface of the glass which created a wavy rippled effect. Additions such as handles and bases were applied either separately or by drawing them out from the body whilst it was still hot. When the glass had cooled, the core was removed by scraping it out with utensils to leave a rough pitted interior and a smooth and colourful exterior.

Four distinctive types of core formed vessels are attributed to the Egyptian period:- the Alabastron (cylindrical or cigar shaped); Amphorisk (pear shaped); Aryballos (globular; and Oinochog (jug with one handle and a flat base).

The oldest known glass vessel is a beaker made in the core-forming style. Made in approximately 1150 B.C., its shape resembles a lotus bud decorated with blue and yellow threads. It bears the name Thotmes III.

Forms were also produced in a core-forming technique without a core. A separating agent was applied onto the rod and the glass was worked directly onto the metal. This method was utilized mainly for more solid objects such as pendants.

The technique of core-forming was slow and laborious and used to produce small, delicate ware, such as perfume bottles, ointment jars and cosmetic containers.

Previous to the development of glass, these objects had been made of stone and it is debatable whether this rock-like quality was then developed deliberately in glass to imitate these rare stones. It is believed that the Egyptians were inspired by the beauty of semi-precious natural stones and precious gems.

The technique of core-forming retained popularity and remained unaltered up until the first century.

The technique of pad glass and tube blown glass were used on a much smaller scale to core-formed glass and did not develop to the same extent.

Pad glass involved spreading and rolling a mass of molten glass over a slab of marble. Utensils were then fashioned from these pads by rolling then into hollow shapes, onto which spouts, bases and handles were fused. Other simpler objects were made by pressing these semi-fused pads into shallow open moulds.

The technique of tube-blown glass superseded pad glass by taking the hot length of glass and rolling it around a metal tube. Thus shaped, it was then closed at one end and reheated and blown by the workman.

1. CORE-FORMED VESSELS

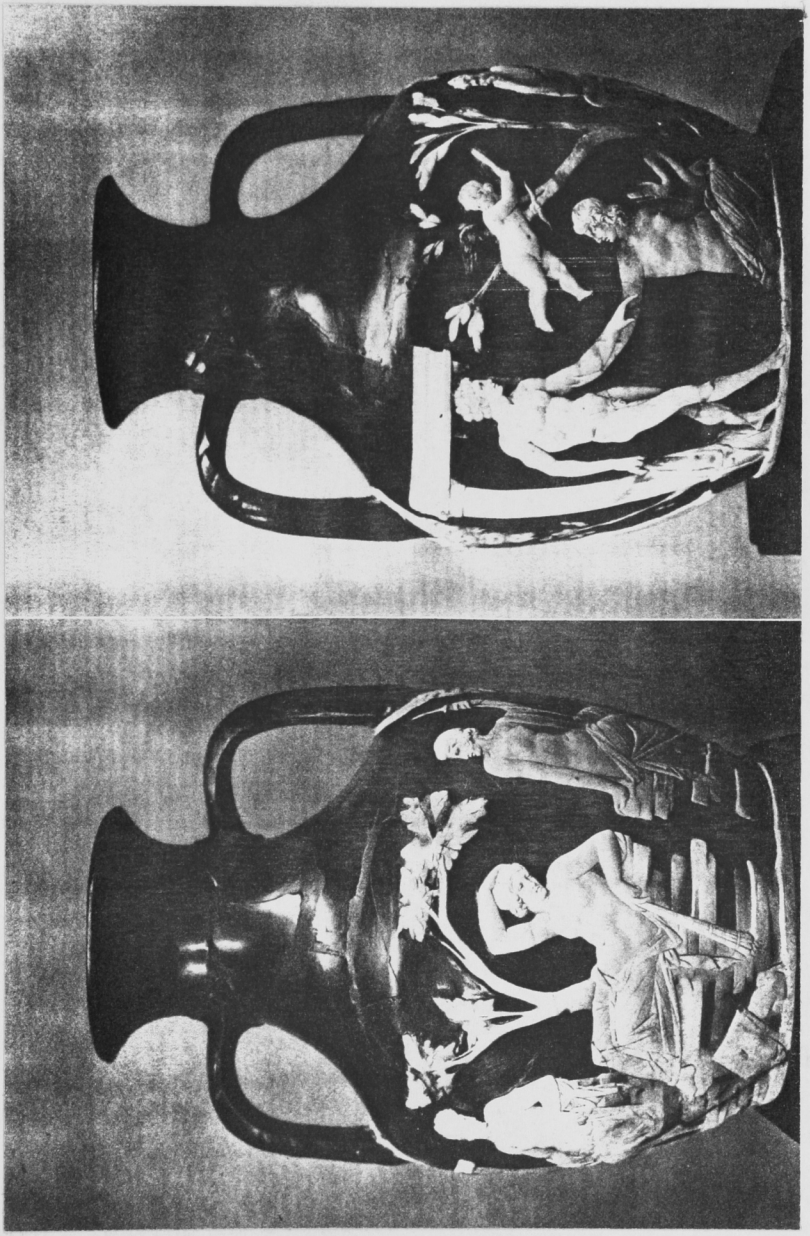
The famous Portland Vase was revealed to have been made in the tube-blown glass method when, in 1848, the vase was smashed by a crazed sailor and it was able (in its bits) to be scientifically analyzed.

The vessel was found to have been executed in three parts, with a layer of opaque white glass over a core of dark blue. The superimposing of colours so that the outer layer could be cut and carved away to create relief scenes is known as cameo.

The vessel was delivered to a gem-cutter to be carved with the depth of the cut resulting in a delicate and subtle surface of engraved glass. The image in various hues, from white to blue.

Tube-blowing presumably predates the discovery of normal pipe blowing, but was perhaps itself the idea which lead to the idea of pipe blowing.

THE PORTLAND VASE



2. THE PORTLAND VASE

THE DISCOVERY CONTINUES

Whilst core-forming was enjoying a popularity, glass was also being discovered further afield and being employed in other methods.

From the bronze age to Roman times man had discovered and perfected many techniques with metal. The advent of glass enabled him to experiment with casting glass into moulds (originally used for metal), fusing, slumping and cire peroue (lost wax) casting with glass.

Many of the first cast glass pieces have similar if not identical replicas in metal as often the moulds were used for both mediums. Casting involved the pouring of molten glass into a pre-heated mould or packing a mould with crushed glass and then heating the mould until the glass crystals liquidized to become a solid mass within the mould. When the glass had cooled (ie annealed) the friable mould was removed to result in a glass negative of the mould.

Initially the vessels produced were cast as "blanks" (term for a simple form) which were later finished cold by cutting, grinding, and polishing on a lathe to achieve a specific shape or surface pattern. As the casters became more adept at the process they began to produce ribbed and patterned moulds so that in the initial firing process. the glass would achieve the desired form.

This method of casting was widely utilized to produce beads, scarabs, amulets, plaques, inlays and cast figurines.

The process of cire perdue (lost wax) casting was an extension of the above casting method. The worker was able to produce a more detailed and complex design by fashioning the model out of wax.
The wax could be fashioned into any intricate pattern before being encased into a mould of refactory material incorporating air and pour holes. When the mould material had set the mould was heated until the wax ran out, leaving in the mould the indentations of the decorations left by the wax model. The mould was then filled with glass to result in an exact replica of the wax in glass. This method of casting liberated the worker from many technical problems as he no longer

3. TWO HANDLED JUG

had to produce a two-part mould to remove the model and did not have to concern himself with the previous inconvenience of undercuts which hindered the removal of a model from a mould. Its disadvantage was that generally each hand-made wax resulted in a one-off piece as the wax form (and subsequently the model) was lost once it had been melted out of the mould.

The method of fusing and slumping was popular with the Romans and often utilized in connection with a special form of glass known as mosaic.

Slumping involved making a sheet of flat glass, either by crucible pouring glass onto a sheet to form a large pancake of glass, or by fusing together pre-formed discs or canes. This sheet was then placed on, in, or over a single mould and heated in a kiln until the glass softened and sagged under its own weight - stretching until it was in full contact with the mould's surface.

Fusing involved assembling glass around a mould (probably ceramic or metal) and then inserting an outer mould on the top of the inner mould to capture the glass in between to hold them in place whilst the heat of the firing fused the glass together to form a solid glass vessel within the mould.

The method of mosaic glass was popular with fusing and slumping as it allowed detailed and colourful fragments to be assembled into one piece.

Mosaic involved building up a design or pattern with glass threads by stacking different coloured canes until a design had been built which was visible from the cross-section of the block of threads.

This block was then fused and heated until it could be stretched into a long length. The longer the mass of glass was stretched the narrower in width it became until it was only the thickness of a pencil. This length is known as a cane. The design in the glass had been stretched so that it remained the same but in minature form, resulting in thousands of tiny detailed pictures when the can was sliced into discs. These discs were then formed or fused in the previously detailed procedures to result in beautiful, colourful and intricate vessels known as mosaic bowls.

The Mesopotamians, according to finds at al Rimah and 'Aquar Quf, were producing a coloured patterned glass known as mosaic which was later to be adopted and developed in 30 B.C. by Italian craftsmen.

4. MOSAIC BOWL

The highly decorative mosaic vessels were owned only by Pharohs and Nobility as glass was regarded as a luxury item. The beauty and execution of these bowls was so magnificent that Cleopatra accumulated a collection of over three thousand bowls.

The techniques of core-forming, and mould forming were used exclusively until the first century to produce glassware. Whilst these methods adequately produced what the craftsmen desired, they were slow and labourious.

The nearing of the turn of the century saw countries more freely engaging in export of wares and the desire for a more productive technique of fashioning glass. A quicker and cheaper method of production was sought in order to supply the rapidly changing world ... and it was soon to be discovered.

THE BIRTH OF CHRIST AND BLOWN GLASS

The blow-pipe. A hollow steel tube approximately five feet long and the object accredited to revolutionizing nearly one thousand years of glass!

In the first century A.D. improved furnaces, advanced technology and a stronger composition of chemicals led to a more viscious, pliable glass which facilitated the possibility to blow glass.

Strabo, a writer of that period, noted that the Romans had been experimenting and investigating with ways to produce a better method to mass produce glass, and glassblowing may have been their result.

Thought to have started in the Syria/Palestine region where the earliest dated blown vessels have been found, the discovery that hollow objects could be fashioned on the end of a pipe and the glass manipulated in this state to adopt a desired form ultimately led to the discontinuance of most core and casting procedures and even the demise of the prominent ceramic industry.

To make a blown vessel the craftsman must take the hollow steel pipe (blowpipe) and twirl the tip of the pipe end into a vat of molten glass to get a "gather", which is a gob of glass on the pipe. The thick liquid can then be shaped with the aid of simple wooden tools and air blown into the hollow pipe until the compressed air enters the molten glass to form a bubble. Periodically reheating the glass ensures its viscous and workable state. The worker alternates between blowing, reheating and shaping the glass until it has achieved its desired form. During this entire process, the pipe on which the glass is attached is rotated constantly to ensure that the molten glass does not deform as its liquid state makes it susceptible to running off the pipe. Even a pause in turning the pipe whilst blowing into it will result in a misshapen form.

When the hollow vessel on the pipe has achieved its desired form its base is heated and flattened with a wooden paddle and the neck of the piece (ie the glass next to the pipe) is touched with a wet or cold instrument to chill the glass, creating a weak spot and enabling a tap to the pipe to crack the vessel from the pipe at the point where it has been chilled. This vessel was often of a tear-shaped bottle, this shape requiring the least skill to make.

Later the punty (or pontil) was devised. This was a small amount of glass on the a solid pipe which was

attached to the underside of the vessel which was then broken off at the neck, the vessel still attached on its bottom to the punty. The opening of the piece was then free to be reheated, smoothed and enlarged. Additions to the vessel such as handles and bases were added at this stage before it was placed into an oven to anneal.

The bench at which the process of blowing took place was known as a chair or bench. Although today its design is almost universal for the first 1500 years of blowing it did not exist.

Historical writings and paintings depicting glassblowing show the worker sitting on a low, three-legged stool, rotating the pipe on his thighs which appear to be clad with a strip of timber around each thigh to protect them from being burnt by the hot pipe.

In 1575 a chair with metal arms extending above the chair was devised to take the pipe and free the workers thigh from being in constant threat of scorching.

Being liberated of the pipe allowed a greater freedom to wield and manipulate the glass in a way not possible when blowing was performed on the thighs.

The discovery of glassblowing brought a complete revolution in the manufacture of glass. The precious substance owned only by Pharohs, High Priests and Nobles ceased to be a luxury material. Its new speedy production soon made glass available and affordable for all people, making it so common that Emperor Gallienus refused to drink out of it, preferring to drink out of his gold cups which had not become household items.

Glass cups and utensils had become widely used in eating houses and drinking bars, and glass was used extensively as storage vessels in shipping, as it did not distort the flavours of food.

Blowing into plain and decorated moulds allowed standardized and duplicate vessels in a variety of styles. The phenomenon of blowing into a mould was discovered in 25 A.D. and allowed amongst other thing the first souvenir items to be produced. In Greece beakers often depicted Gods and Heroes, whilst in the Roman sector Gladiators and Charioteers usually identified by name were common reliefs on blown glass.

Mould blowing developed to give bottles whose body was of a grape cluster shape, and heads of state were often immortalised on the surface of glass bottles to act as objects of caricature in Nero's Rome. After being blown into the head-shaped mould, the glass could be

further worked or blown to distort to unflattering proportions the head depicted.

For the first time in glass history the advent of mould blowing saw the signature of the mould maker appearing on the glass piece. The maker engraved his name into this mould so that every piece blown into it would carry his mark. Many examples survive today by the maker known as "Ennion Made Me".

A short two hundred years after it emerged, the art of glassblowing had begun to lose its prestige and desirability as its purpose became more mundane and common. Had it not been for the interest of the Italians and their vigor in the glassfield, it is unlikely that glass would have ever recaptured it's former glory and value. The Italians used blowing to once again elevate the standing of glass to that of gold and gems.

ON THE SIXTH DAY

In 1961-2, the discovery of glass furnace remains on the Island of Torcello in the Venetian lagoon, dated 600-650 A.D., suggested or at least implied that glass manufacturing techniques persisted in the vicinity of Venice throughout the Dark Ages. If this is true, it could explain the exceptionally early re-emergence in the tenth century A.D., of factor which contributed to the quick and successful growth of the industry during the Middle Ages.

When glassblowing had been invented, its transformation into a cheap commodity provided the stimulus for the proliferation of glasshouses throughout the Roman empire.

The Roman empire consisted of the United Kingdom, France, Spain, Portugal, parts of the Netherlands, Germany, Belgium, Switzerland, Eastern Europe, Turkey, The Middle East and North Africa. Thus all major glasshouses were under Roman rule and glass production was essentially Roman until the collapse of the Roman empire in the west after 400 A.D.

In 1200 A.D., the Venetians formed a guild in order that they be able to represent their craft along with others in a procession through the city celebrating the inauguration of the reign of the new Doge (government). This guild grew into a powerful co-operative later known as the Capitolare, which was granted the power to impose strict rules and sanctions on all glasshouses in Venice to ensure that the quality of the glassware being produced was of a high standard and that the work procedure and workshops were managed in a way that suited the authorities control over the exports and industrial safety.

It was this concern for safety which saw the glass industry forced by authorities to move to the neighbouring island of Murano in 1291. The threat of fire on the mainland was regarded as a potential disaster due to the heat created in the workshops and the crowded building situation.

Murano had until then been exclusively a summer resort for the rich aristocrats who had villas on the island. Murano had been granted in 1275 its own independent local administration, a sanction which proved to be very convenient for the glassworkers.

The glasspeople happily obliged in moving to Murano to live on the tiny paradise and the aristocrats did not

oppose the idea with the threat of fire from furnaces being based so close to their villas.

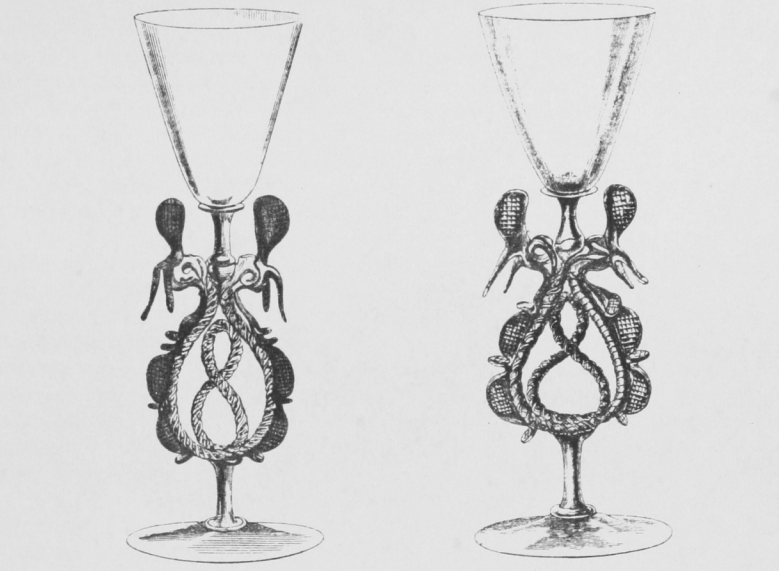
On Murano the Venetian glassblowers excelled and produced work which was soon to herald them as Maestro's of glass.

In 1500 the glassmakers had developed a formula for an almost colourless soda-lime glass which they named "CRISTALLO" after the rock crystal quartz it resembled. A soft and malleable glass, it had a long working time enabling it to be blown into extremely thin-walled vessels and fanciful shapes. Its elastic properties enabled the workers to execute forms of decoration which became principally associated with the popular conception of Venetian glass. These decoration involved ornamental stems for wine glasses with wing-like appendages upon which a further zig-zag trailing of glass was applied, known as a rigoree. Eventually, the decoration overtook the function of the stem and it evolved into complicated twists of glass resembling snakes or eagles.

Venetian work became the most sought after glass in the world, and their method of manufacture remained a mystery to the outside world.

Not until the Renaissance did glass commonly known as Venetian reach any degree of perfection, thus with its sudden world-wide appreciation the Capitolare recognized the Venetians monopoly of the glassworld and strove to maintain it. The knowledge of construction of furnaces, glass formulas and proportions of ingredients as well as the making and handling of tools were passed on solely to trainees who swore loyalty to the Venetian trade. Revelation of their knowledge to outside sources who might possibly imitate the Venetians popular style could become competition and a threat to the Venetian monopoly of style.

Concessions were granted which altered the rank of glassblowers to patrician standing, allowing sons of noble families to marry their daughters of glassblowers without forfeiting their rank. This limited recognition was a measure of how the glassworkers had been elevated in rank as Venice began to recognize their economic importance to the country. However, they were not the only ones who recognized the value of the glassworkers skill. European countries who wanted to cash in on the Venetian success attempted to lure master blowers away from the island with attractive proposals.



5. VENETIAN GOBLETS

The Guild of Glassmakers had by now, 1490, surrender their limited power to the Council of Ten, the highest body in the Venetian republic to manage the Venetian glass industry. They fought constantly to maintain, during the fifty subsequent years, the control of a developing industry which was vital to their economic status and desperately sought by competitive countries. In response to the attractive offers rival countries were extending to Venetian workers, the Council of Ten issued an edict threatening death to any worker who disclosed the secrets of the industry to another country. When Emperor Leopoloi did lure some glassmakers to Austria in the seventeenth century, the Venetian senate punished those who did not return by imprisoning their nearest relatives. In contrast to this terror, the republic granted loyal glassmakers considerable privileges and improved their standard of living considerably. The distance of Murano from the mainland also ensured that the actions and movements of the glassblowers could be carefully monitored to reduce the chance of desertion by the workers.

Murano and it's glass industry reached its pinnacle of success in the sixteenth century. Writer James Howell acknowledged their skill by suggesting that the superior quality of the glass produced on the island was due to "the quality of the circumambient air that hangs o'er the place", such was the unequalled beauty of the glass produced on Murano. These compliments had been earned by the Venetians who had worked hard to produce good quality glass from the material itself to the glassware.

Their success with Cristallo glass arose from their pursuit of higher quality materials to manufacture the glass. The extraordinary efforts included importing natron (a soda) from the Middle East which was superior to the more common and accessible soda, barilla. Products such as alum from Alexandria commonly used in glass manufacture were forbidden to be used in Venetian glass recipes for, although it was cheap, it produced an inferior glass and was subsequently banned in edicts of 1306 and 1336.

Success within the industry was also due to the excellent mercantile fleets and commercial relationships with other countries which enabled them to establish business ties throughout the Mediterranean and supply the demand for glass.

However, the Venetian's dominance and popularity in the glass industry, like all good things, was not to last. What goes up must come down, and the Venetians "downer" came in the form of Antonio Neri, a Florentine priest who did the unthinkable and published in 1612, a book

entitled "The Art of Glass". In the style of the Venetian authorities worst dreams the book divulged all that the Venetians had been trying to keep secret for so long. It was devoted entirely to revealing the techniques the Venetians had mastered and monopolized to produce their intricate glassware. Instruction on how to blow glass, wield tools and glass recipes were exposed for all the world to see. This catastrophe was aggravated by circumstances uncontrolled within the Italian borders. Whilst the Capitolare had issued stringent laws to protect glasshouses on Murano, it had been lax in maintaining these laws throughout the country. Thus glasshouses had been allowed to flourish in other cities unregulated and with the precious knowledge of Venetian glass. It was this which enabled Neri to compile his book. One glasshouse in particular contributed extensively to the spreading of technical secrets. Apart from the Venetians a glasshouse situated in the industrious village of Altare was the only other significant body to contribute to the establishment of Italian glassmaking. In contrast to the Murano workers, the glassworkers from the village of Altare were allowed to move freely over the border and back at will, and did so frequently to visit nearby France. The power of the Venetian authorities were steadily waning during this period due to interminable civil wars, foreign invasions and a succession of weak emperors. Incentive to go abroad was strong and increasingly many did to settle in France, and then Orleans ... and to Paris .... In 1548, fourteen years before Neri's book, they had even established a glasshouse in Saint-Germain-des-pres. The threat the village Altarists had contributed to the Venetian loss of monopoly cannot be assessed, although it can only be reasoned that they certainly hastened the worlds knowledge of Italian techniques. Along with Neri's book the Altarists spread and implemented many of the Venetian techniques in foreign countries where they were quickly adopted.
Thanks to the Altarists and Neri, by the end of the sixteenth century more advanced glassworks in central Europe were producing "Facon de Venise", ie works in the Venetian style as well as the clear and green glass from the medieval traditions. Bohemian glass merchants had begun to gain popularity in the European glass trade, as they embarked upon new techniques, such as cutting and engraving on high quality lead crystal, producing lower priced glassware in comparison to imported Venetian products.

The Venetians were no longer unrivalled in their dominance of sea-trade and these social/political factors also contributed greatly to the Venetians sudden loss of popularity.

By the turn of the eighteenth century, Bohemian glass had become so popular that even the Murano glassmakers tried to imitate it in both composition and decoration.

The qualities of "Crystallo" which had made Venetian glass forms so successful did not lend itself well to the heavier Bohemian forms and not surprisingly, Venetian work lost its previous individuality and popularity. It has been suggested that had the Venetians persevered with their own style in which they excelled, the enthusiasm which had greeted Bohemian glass would have subsided and the Venetians subsequent century of waning popularity could have been avoided.

By the beginning of the nineteenth century, glassmaking in Murano had practically ceased to exist. The number of workers on Murano connected with glassmaking had dropped from three thousand to a mere 383 and the guild and it's strict regulations which were inforced by the Capitolare, had been disbanded in view of the disheartening emigration of many master craftsmen to rival countries (like rats leaving a sinking ship).

The supreme reign of Venetian glass had suffered from the turbulence and competition its country had been subjected to and its centuries of popularity came to an end.

ON THE SEVENTH DAY

Today in 1990 (almost 800 years since the first glassmakers moved to Murano), we are witnessing a strong recognition of that 800 years of glassmaking. History is repeating itself as countries adopt the techniques of "Facon de Venise", gaining their knowledge from glassmakers who readily leave the island to demonstrate their techniques. The difference is that now they leave by aeroplane to lands across the world which had yet to be discovered at the time of the first fleeing of the island.

Glass is produced to this day in the countries of its origin and probably is some form in almost every country in the world.

From its humble beginnings glass is still being created by nature, and the basic recipe which has formulated four thousand years of glassmaking is still the foundation on which all complex scientific and specific recipes are built.

Glass is now a common indispensable household material and has been widely developed for use in the finer arts.

Countries have developed their own distinguishing styles. The Venetian techniques are as thriving and popular today as they were when they were developed.

The future of glass is as mysterious as its beginnings and its potential as great as its qualities and its uses as diverse.

This paper is a mere fragment in the great history of glass which is continually growing from its beginning 4000 years ago.

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